

Project Introduction

Project Importance:

- Avionics and Software (A&S) are the foundation that enables the command, control, communications, and computing (C4) capabilities needed to operate a spacecraft and subsystems

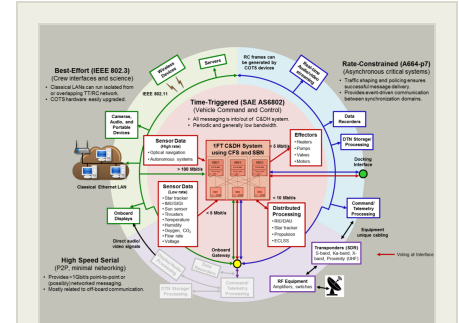
Project Goal:

- Define, implement and exercise an avionics and software architecture that is **open-source, highly reliable with fault tolerance**, and utilizes **standard capabilities and interfaces**, which are **scalable and customizable** to support future exploration missions
- Infuse resultant technologies, standards, and architectures into new and existing human spaceflight programs

Key Project Drivers:

- Increased Affordability through Technology Transparency and Reuse**
 - Advance open technologies and standards
 - Enable competition and diversity in avionics hardware solutions
 - The underlying hardware should not have any impact on an application either during development or execution
 - Develop reusable software and tools with broad program applicability
- Reliability and Maintenance**
 - Operate in the presence of failures so that Maintenance Free Operating Periods (MFOPS) can be achieved
 - Provide capabilities that enable autonomous operations
 - Minimize unique sparing
- Incremental Update & Certification - Designed for Growth and Change**
 - Applications can be inserted/alterred with minimum impact on other systems and on the supporting safety case
 - Flexible scheduling to meet the deadlines of all the applications for each viable configuration and when system is upgraded

Project Focus Areas and Objectives:



Avionics and Software Distributed Integrated Modular Avionics (DIMA) Architecture

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Avionics and Software Project (A&S)

Completed Technology Project (2014 - 2021)



- **Command & Data Handling (C&DH)** - Define a reliable, high-performance & modular C&DH architecture and build HW catalog
- **Software** - Provide a reusable software architecture and tools suitable for human-rated missions
- **Human Interfaces** - Identify, integrate & test human interface technologies that are scalable, sustainable, and evolvable to support future exploration
- **Communication and Wireless Systems** - Enable interoperable, wireless & networked communication for inter/intra-vehicle systems
- **Systems Engineering and Integration (SE&I)** - Model, build & test flexible and robust integrated vehicle systems

Project Activities:

- Partner with Orion to develop and deliver a Core Flight Software (cFS) based Backup Flight Software (BFS) system for the Artemis missions. BFS is a dissimilar flight software system on Orion that mitigates against a common-cause primary computer failure to reduce the probability of Loss of Crew. This partnership advances cFS capabilities and tools that are broadly applicable spaceflight and delivers modular, re-usable spacecraft algorithms for GN&C and systems control.
- Enable early integrated avionics and software validation and testing activities between Artemis mission elements (Orion, Gateway, HLS, etc.) and Orion Display & Control hardware software integration and human in the loop testing by enhancing and improving SOCRATES (Software Only CEV Risk Reduction Analysis and Test Engineering Simulation) interfaces.
- Provide stewardship, development, and maintenance of the open Core Flight Software and Tabella Web Based Graphical User Interface product lines.
- Complete Interoperability testing and finalize the Comm and Wireless Consultative Committee for Space Data Systems (CCSDS) Proximity Wireless Network Technology Blue Book.
- Leverage years of hands on expertise in fault-tolerant triplex-voting, Distributed Integrated Modular Avionics (DIMA), NASA's Core Flight Software (CFS), and Time-Triggered Ethernet (TTE) to enable Artemis success.

Anticipated Benefits**Project Benefits:****Organizational Responsibility****Responsible Mission Directorate:**

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Exploration Capabilities

Project Management**Program Director:**

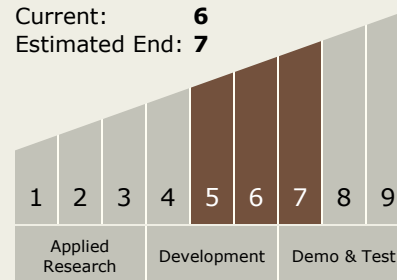
Christopher L Moore

Project Manager:

Brian M Schwing

Technology Maturity (TRL)

Start: 5
 Current: 6
 Estimated End: 7

**Technology Areas****Primary:***Continued on following page.*

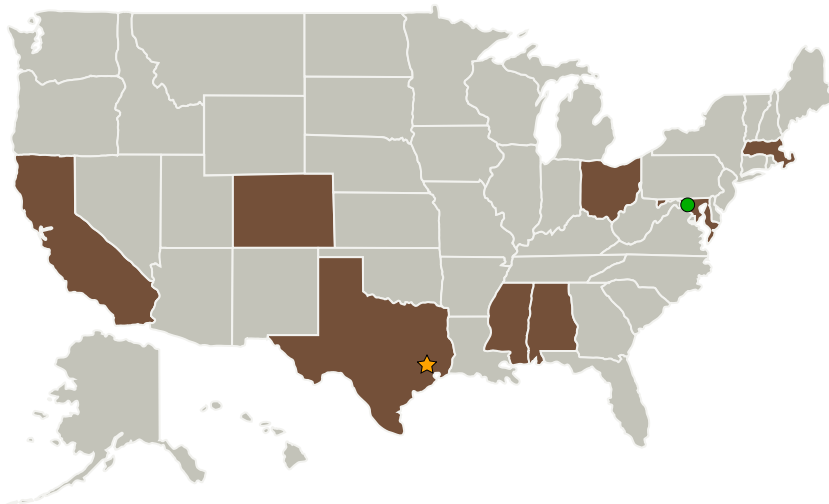
Avionics and Software Project (A&S)

Completed Technology Project (2014 - 2021)



- Results in an open architecture that allows use of hardware from multiple vendors
- Enables use of evolving (near-launch) technology
- Ability to upgrade capabilities and infuse new technologies with cost-effective validation

Primary U.S. Work Locations and Key Partners

Technology Areas
(cont.)

- TX07 Exploration Destination Systems
 - └ TX07.3 Mission Operations and Safety
 - └ TX07.3.2 Integrated Flight Operations Systems

Target Destinations

The Moon, Mars, Others Inside the Solar System

Supported Mission
Type

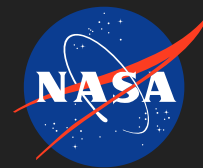
Planned Mission (Pull)

Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Exploration Capabilities

Avionics and Software Project (A&S)

Completed Technology Project (2014 - 2021)

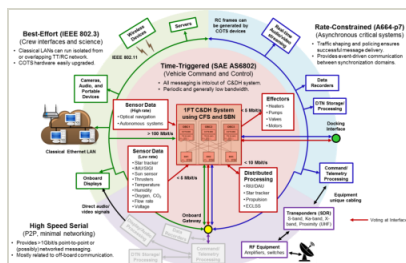


Co-Funding Partners	Type	Location
Jacobs Engineering Group, Inc.	Industry	Dallas, Texas
METECS	Industry	Houston, Texas
Odyssey Space Research, LLC	Industry Women-Owned Small Business (WOSB)	Houston, Texas
The Charles Stark Draper Laboratory, Inc.	R&D Center	Cambridge, Massachusetts

Primary U.S. Work Locations

Alabama	California
Colorado	Maryland
Massachusetts	Mississippi
Ohio	Texas

Images



Avionics and Software Distributed Integrated Modular Avionics (DIMA) Architecture

Avionics and Software Distributed Integrated Modular Avionics (DIMA) Architecture
(<https://techport.nasa.gov/image/41322>)

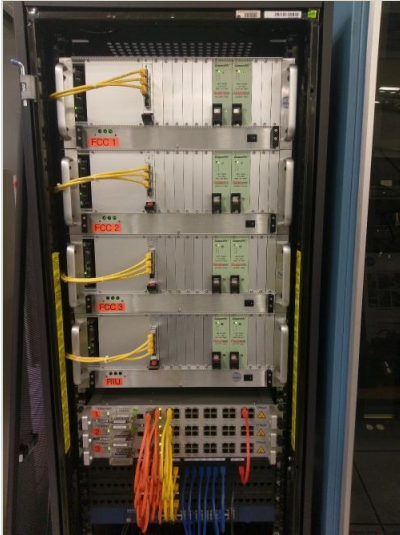
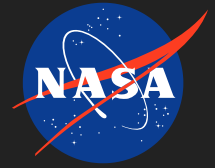


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For more information and an accessible alternative, please visit:
<https://techport.nasa.gov/view/32947>

Avionics and Software Project (A&S)

Completed Technology Project (2014 - 2021)



Avionics and Software Reference Implementation

A&S architecture implemented on available COTS hardware in the integrated Power, Avionics and Software (iPAS) facility at JSC (<https://techport.nasa.gov/image/41323>)